HLI HEKIMIAN LABORATORIES, INC.

A subsidiary of A. Johnson & Co., Inc.

OPERATING MANUAL
MODEL 42-10
TRANSMISSION TEST SET

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MODEL 42-10
TRANSMISSION TEST SET

Manufactured by

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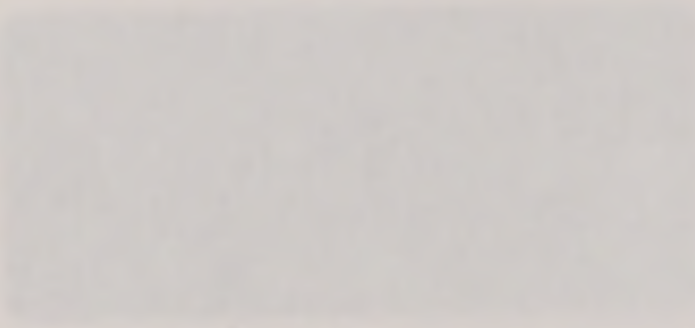

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1. INTRODUCTION

1.1 General Description

The Model 42-10 TRANSMISSION TEST SET combines the functions of level, noise, and frequency measurements with a flexible signal generator in a compact, portable instrument designed to fill a variety of requirements. It features a high level of reliability, accuracy, and operating convenience.

Dual digital displays simultaneously present fully autoranged level or noise measurements and frequency readings from 40 Hz to 20 kHz. Indicating push-button switches are arranged for ease of operation, and all variable controls have excellent resolution and setability. Independent selection of receive and send impedances and an audio monitor add to the unit's flexibility.

Level measurements are made directly in dBm using an average type detector in compliance with Bell System Standards. Noise measurements are made directly in dBrn using a quasi-RMS detector. Program, C-Message, 3 kHz flat, and 15 kHz flat weighting filters are front panel selected and meet the revised (1975) Bell System Standards.

A second display provides a fast update, fully autoranging 4-digit frequency readout in kHz with a 1 Hz or 10 Hz resolution.

The flexible signal generator features both continuous and 100.4 Hz step frequency coverage. For noise measurement, both a 1004 Hz holding tone and a quiet termination are provided. In addition, the unit features two fixed frequencies and one fixed level.

The Model 42-10 is a rugged, compact instrument powered by a self-contained power supply which draws 15 watts from the commercial ac power line. The test set is optionally available with an internal rechargeable battery supply. The power cord and fuse are located inside the rear panel storage compartment.

1.2 Specifications

The electrical and mechanical specifications for the Model 42-10 are listed in Table 1-1.

A front view and a rear view of the Model 42-10 are shown in Figure 1-1.

TABLE 1-1

SPECIFICATIONS

GENERAL		
	Measurements	Level (dBm), noise (dBrn), noise-to-ground (dBrn), frequency (kHz)
	Displays	Dual display, level or noise, and frequency
	Generator	Sine wave, fixed and variable frequency, fixed and variable level
	Dial/Talk	Full 2-wire/4-wire capability with dual electronic hold circuits
	Line Select	Receive/send transfer switch
	Audio Monitor	Front panel volume control
INPUT		
	Impedance	600 Ω, 900 Ω, bridged (balanced)
	Return Loss	>30 dB, 200 Hz to 20 kHz
	Balance	>60 dB up to 4 kHz
	Line Hold	Dual electronic hold, nominal 26 mA
LEVEL MEASUREMENT		
	Frequency Range	40 Hz to 20 kHz
	Measurement Range	-80.0 dBm to +10.0 dBm, full autoranging
	Accuracy	dBm

dBm	40 Hz	100 Hz	4 kHz	20 kHz
+10	±0.5	+0.2 dB**	+0.5	
-40	±1.0	±1.0 dB	±1.0	
-70				

** ±0.1 dB at 1000 Hz for levels between 0 and -19 dBm

	Detector Type	Average
NOISE MEASUREMENT		
	Modes	Noise (message circuit) Noise-to-ground

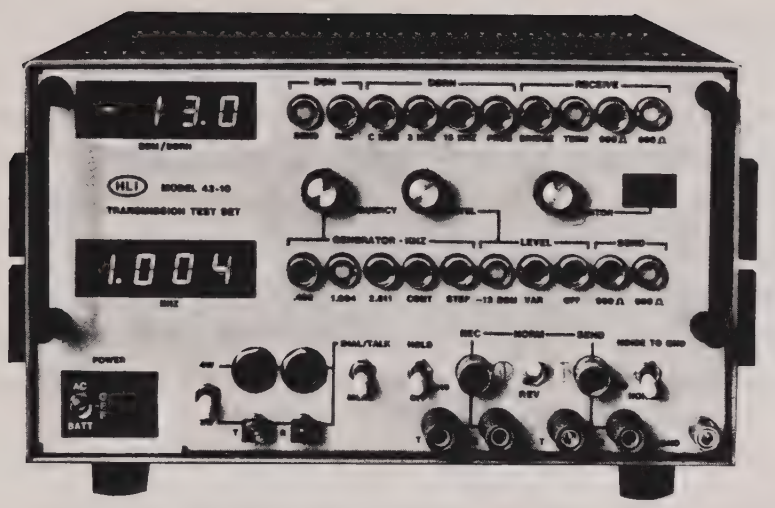
TABLE 1-1 (cont.)

NOISE MEASUREMENT (cont.)		
	Weighting Filters	C-Message 3 kHz flat Program 15 kHz flat 1010 Hz notch on all filters*
	Measurement Range	+10 to +100 dBrn (noise) +40 to +130 dBrn (noise-to-ground) Full autoranging
	Accuracy	±1.0 dB (noise), +20 to +100 dBrn ±1.5 dB (noise-to-ground), +50 to +130 dBrn
	Detector Type	Quasi-RMS
FREQUENCY MEASUREMENT		
	Frequency Range	40 Hz to 20 kHz, full autoranging
	Level Range	-40 dBm to +10 dBm
	Resolution/Update	0.040 to 9.999 kHz/7 times per second 10.00 to 20.00 kHz/7 times per second
	Accuracy	±1 count
GENERATOR		
	Frequency Range	40 Hz to 20 kHz
	Modes	Continuous 100.4 Hz stepped* 402 Hz, fixed* 1004 Hz, fixed 2811 Hz, fixed* OFF (quiet termination)
	Level Range	-40 dBm to +10 dBm, continuously adjustable* -13 dBm, fixed* (set at 1004 Hz)
	Distortion	>60 dB, 1004 Hz fixed >50 dB, 200 Hz to 4000 Hz >40 dB, 40 Hz to 20 kHz
	Impedance	600 Ω, 900 Ω (balanced)
	Return Loss	>30 dB, 200 Hz to 20 kHz
CONNECTORS		
	Receive/send	310 type jacks/5-way binding posts
	4W Talk	310 type jacks
	2W Dial/Talk	Cuff Links
POWER		105-130, 210-260 V ac, 47-63 Hz, 15 watts
SIZE		9-1/2" (24.1 cm.) W x 5" (14.0 cm.) H x 15" (38.1 cm.) D with cover
		*See Option List

TABLE 1-1 (cont.)

WEIGHT	20 lbs. (9.1 kg.) with battery
OPTIONS	-2. Rechargeable battery pack/ac supply -4. Alternate fixed frequencies in place of 402 and 2811 Hz. Must be below 4.0 kHz and multiples of 100.4 Hz (100.0 Hz with option -14). -6. Alternate fixed generator level in place of -13 dBm output -13. Rack mounting panel and hardware - specify rack width, vertical height increment, and mounting details -14. 100.0 Hz step in place of 100.4 Hz -16. Switched notch filter -17. Dual range output level control

HLI reserves the right to make changes in specifications at any time without notice.



FRONT VIEW

REAR VIEW

FIGURE 1-1. MODEL 42-10 TRANSMISSION TEST SET

2. INSTALLATION

2.1 General

The Model 42-10 TRANSMISSION TEST SET is designed for ease of operation and installation. After the unit has been removed from its shipping container, perform a complete visual inspection for possible damage. If damage is found, notify the carrier immediately; do not destroy any packing material until an agent of the carrier has examined it. Under U.S. shipping regulations, damage claims must be submitted by the consignee; do not return the instrument to Hekimian Laboratories, Inc., until a claim for damages has been established.

All internal adjustments have been set at the factory and no further adjustments are required prior to installation or use of the equipment.

2.2 Installation

Power for the unit is supplied either from the ac power line via the line cord or from internal rechargeable batteries. The batteries will be charged as long as the unit is connected to the ac power line. Access to the ac line cord and main fuse is made by removal of the storage compartment cover on the rear of the unit as shown in Figure 1-1. This compartment is provided for storage of the ac line cord and other small adapters or test cables that may be used with the test set. The storage compartment cover may be attached to the unit with the ac line cord either in or out.

Signal receive/send lines are connected to the front panel Western Electric 310 type jacks or 5-way binding posts. Shielded cable is recommended for all signal connections.

2.3 Subassembly Replacement

This section contains the removal instructions for the Model 42-10 printed circuit boards as shown in Figure 2-1 and batteries (optional) as shown in Figure 2-2.

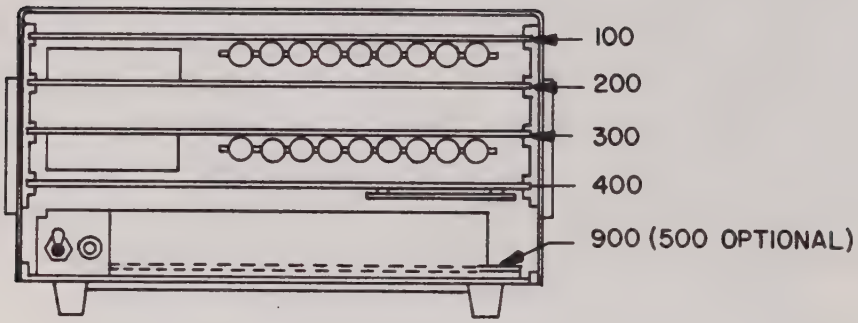


FIGURE 2-1. LOCATION OF PRINTED CIRCUIT BOARDS

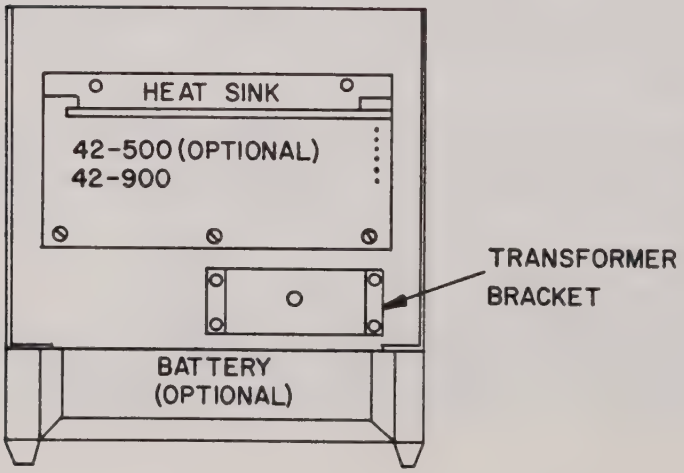


FIGURE 2-2. SUBASSEMBLY REPLACEMENT

2.3.1 Main Printed Circuit Boards

There are two pairs of printed circuit boards. The upper pair contains the receive circuitry and digital voltmeter (100/200 bd.). The lower pair contains the clock circuitry, frequency counter, and generator (300/400 bd.). Refer to Figure 2-1.

Note: To maintain proper calibration, these boards must always be replaced in pairs (100/200 bd. or 300/400 bd.).

To remove the printed circuit board pairs, remove the two front panel attachment screws on each side of the test set as whown in Figure 2-3. Lift the front panel straight out and then to the right. The board pairs may then be removed by gripping the switch brackets and gently pulling forward.

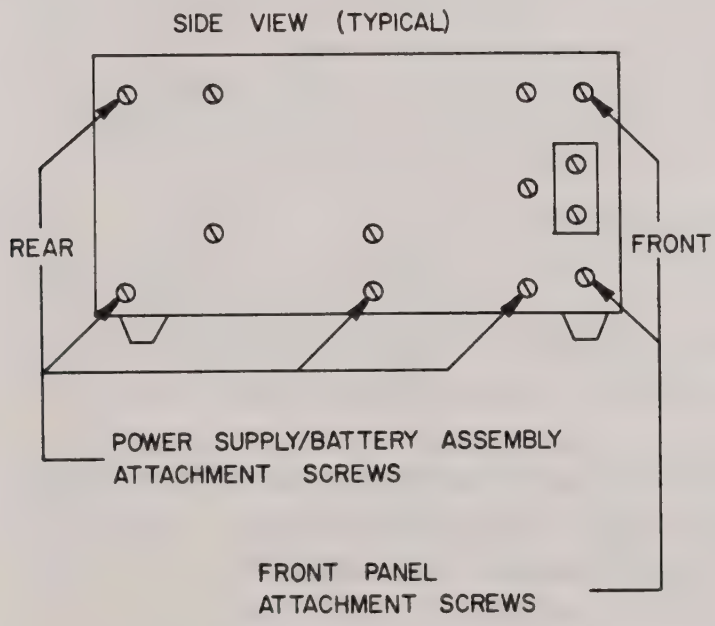


FIGURE 2-3. ASSEMBLY/DISASSEMBLY SCREW LOCATIONS

To replace the board pairs, line the switch board up with the highest or lowest card guide and gently push the board pair into the unit until fully seated in the rear panel connector. Line up the front panel and position it over the switch pushbuttons. Replace the four mounting screws.

2.3.2 Power Supply Assembly

The power supply and batteries (optional), as shown in Figure 2-2, make up a separate subassembly mounted on the bottom plate of the test set. To remove the power supply assembly, remove the power supply mounting screws shown in Figure 2-3 from each side of the unit.

Separate the power supply assembly and mainframe by gently lifting the mainframe up and to the front of the power supply assembly. Remove the flat cable connector which feeds the mainframe from the power supply. The power supply assembly can then be repaired or replaced.

To reassemble the unit, connect the flat cable connector to the power supply and reassemble the mainframe and power supply assemblies.

2.3.3 Batteries (Optional)

As an option, the unit is powered by two 12 V rechargeable batteries. These batteries have been selected for minimum maintenance and long life.

If it becomes necessary to replace the batteries or the fuses for the battery charging circuitry, remove the power supply assembly as described in Section 2.3.2. Once the power supply assembly is separated from the mainframe, remove the two screws on each side of the battery tray. Remove the batteries by lifting them up and out of the battery holder. Care should be taken to ensure that the battery leads are not reversed. The violet wire goes to the negative terminal of one battery while the red wire goes to the positive terminal of the other battery. The white/black wires go to the one remaining terminal of each battery on each side of the unit. The fuses for the battery charging circuitry are located on the power supply board and can be easily replaced once the power supply assembly has been separated from the mainframe.

3. OPERATION

3.1 General

This section contains a description of the controls and indicators, operating procedures, and methods of measurement to be used for the Model 42-10. Prior to operation, be sure that all connections to the instrument are made in accordance with the instructions in Section 2.0.

The Model 42-10 block diagram is shown in Figure 3-1. The generator section (400 bd.) consists of a 1004 Hz test tone sine wave generator and a continuously variable oscillator which may be frequency locked in 100.4 Hz (100 Hz optional) step intervals. For fixed frequencies other than 1004 Hz, the unit is internally connected in the 100.4 Hz step mode. The desired mode of operation is fed to the send amplifier (400 bd.) whose amplitude is controlled by the front panel generator LEVEL control.

The receiver can be selected to measure either level or noise. In the noise mode, a 1010 Hz notch filter (100 bd.) is inserted before the noise weighting filters (100 bd.). When a desired mode has been selected, the signal is then fed to the autorange amplifier (100 bd.), detectors (200 bd.), and digital voltmeter (200 bd.). Connections are also made to the frequency counter (300 bd.) and audio monitor amplifier (400 bd.).

The master clock is a 2 MHz oscillator (300 bd.) from which all other timing pulses are derived. This oscillator is also used to derive the fixed 1004 Hz test tone.

The unit is powered from either the ac power line or optional rechargeable batteries. The power supply assembly contains the battery chargers, regulated ±9 V dc power supplies and a regulated +5 V dc power supply used to power the displays.

3.2 Controls and Indicators

The controls and indicators used in the operation of the Model 42-10 are described in Table 3-1. All controls and indicators are located on the front panel and are shown in Figure 1-1. Internal adjustments are not required.

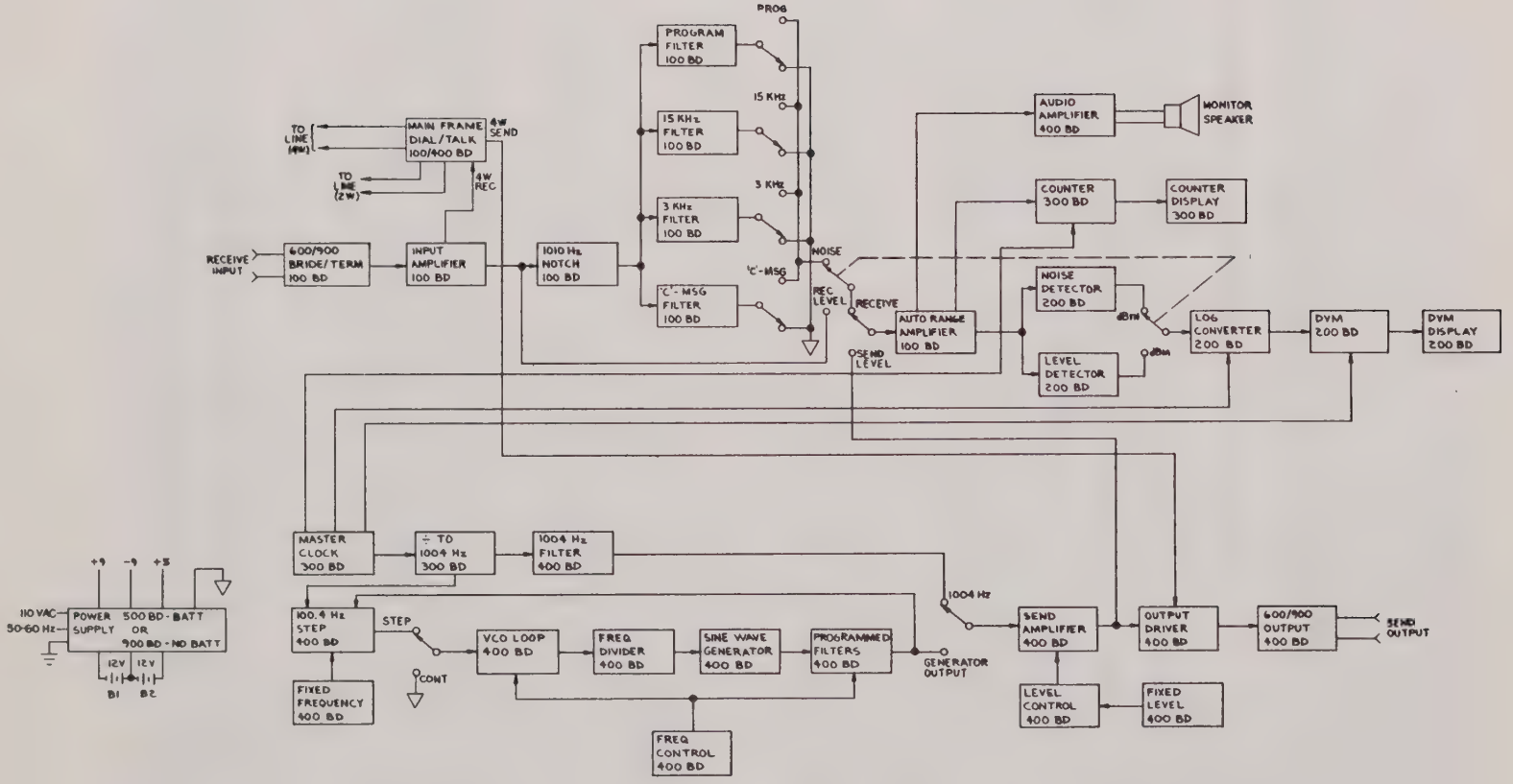


FIGURE 3-1. MODEL 42-10 BLOCK DIAGRAM

TABLE 3-1

CONTROLS AND INDICATORS

Designation	Function
RECEIVE Pushbutton Switches	Selects either 600 Ω or 900 Ω impedance, terminated or bridged modes.
DBRN Pushbutton Switches	Selects and places the 3 kHz, 15 kHz, C-Message, or program weighting filter in series with the notch filter. When one of the noise weighting filters is selected, a quasi-RMS detector is used and the LEVEL displays dBrn directly. When noise measurements are being made, the frequency KHZ counter display is blanked.
DBM Pushbutton Switches	Selects either send or receive level. The average detector is used for level measurement and the level meter will display level directly in dBm. In this mode, the counter displays the frequency of the measured signal.
GENERATOR KHZ Pushbutton Switches	Selects the desired generator mode.
FREQUENCY Control	Sets the desired frequency in continuous or 100.4 Hz stepped mode of operation.
LEVEL Pushbutton Switches	Selects either the fixed level (-13 dBm), variable level, or the quiet termination (OFF).
LEVEL Control	Sets the desired send level in the variable mode.
SEND Pushbutton Switches	Selects either 600 Ω or 900 Ω impedance and sets the dBm reference impedance for the generator.
MONITOR Control	Controls the monitor speaker level.
NOISE TO GND/NORMAL Switch	Selects the noise-to-ground measurement mode when one of the noise weighting filters is selected. The level meter display reads directly in dBrn without corrections or dB additions.
NORM/REV Switch	Selects which of the jacks is internally connected for the send/receive measurements. Transfers the send/receive function for 2-wire operation.
2-Wire HOLD/OFF Switch	Places an electronic hold circuit across the send and receive lines when not in the 2-wire dial mode of operation.

TABLE 3-1 (cont.)

Designation	Function
DIAL-TALK/MEAS Switch	Internally connects either the 4-wire talk circuitry to the send and receive inputs or connects the 2-wire dial connectors to the receive TIP and RING jacks (NORM) or to the send TIP and RING jacks (REV), depending upon the position of the 2W/4W switch.
AC/OFF/(BATT) Switch	Controls the ac primary power or battery power (optional) to the instrument.
Battery Indicator LED (optional)	Provides visual indication of state of charge of internal batteries. For proper indication, the ac power cord should be disconnected and the POWER switch set to BATT position.
2W/4W Switch	Selects either the 2-wire or 4-wire mode of operation for complete dial/talk capability.
HIGH/FLOAT Charge Switch (Optional) (located on bottom of chassis)	Controls the battery charge voltage. The switch is normally left in the FLOAT position.

3.3 Operating Adjustments

This section presents the operating adjustments used with the Model 42-10 TRANSMISSION TEST SET. Connections to the send and receive jacks are made in accordance with the instructions given in Section 2.

3.3.1 Receive Measurements

This section contains the operating instructions used for the receive level meter.

3.3.1.1 Receive Input Impedance

Select the receiver reference impedance by pressing either the RECEIVE 600 Ω or RECEIVE 900 Ω pushbutton. Select either the terminated or bridged mode by pressing either the RECEIVE TERM or RECEIVE BRIDGE pushbutton.

3.3.1.2 Level Measurement

When the receive input impedance has been properly selected, press the DBM REC pushbutton switch. This selects the average detector and indicates level directly in dBm referenced to the selected receive impedance.

The range of level measurement is -80 to +10 dBm. When the input is above or below this range the display numbers will blank, leaving an illuminated + sign when the input is above +10 dBm or a - sign when the input is below -80 dBm.

3.3.1.3 Noise Measurements

Message circuit noise is measured by pressing the DBRN C-MSG, DBRN 3 KHZ, DBRN 15 KHZ or DBRN PROG filter pushbutton. A 1010 Hz notch filter is automatically inserted before the selected noise weighting filter. All noise measurements are read out directly in dBrn.

The range of noise measurements is +10 to +100 dBrn. When the input is above or below this range, the display numbers will blank, leaving an illuminated + sign when the input is above +100 dBrn, or a - sign when the input is below +10 dBrn.

3.3.1.4 Noise-to-Ground Measurements

Noise-to-ground measurements are made by setting the NOISE TO GND/ NORMAL switch to NOISE TO GND. Either DBRN C-MSG, DBRN 3 KHZ, DBRN 15 KHZ or DBRN PROG must be selected. The level meter display reads directly in dBrn without corrections or dB additions.

The ground connection to the test set is made to either the front panel ground post or the sleeve(s) connections of either the SEND or REC front panel 310 jacks.

The range of noise measurements is +40 to +130 dBrn. When the input is above or below this range, the display numbers will blank, leaving an illuminated + sign when the input is above +130 dBrn, or a - sign when the input is below +40 dBrn.

3.3.2 Frequency Measurement

The input to the frequency counter is controlled by the DBM pushbuttons. The input to the counter is selected by pressing either the DBM SEND or DBM REC pushbutton. When a noise measurement is being made, the counter display is automatically blanked.

If the frequency display is all 0's when the DBM REC pushbutton is pressed, the receive level is below approximately -45 dBm.

3.3.3 Audio Monitor

The input to the audio monitor is controlled by the DBM and DBRN pushbuttons. The level to the audio monitor is controlled by the front panel MONITOR control.

3.3.4 Generator

This section contains the operating instructions used for the Model 42-10 generator. To measure the generator frequency and level, press the DBM SEND pushbutton. Select the desired send impedance by pressing either the SEND 600 Ω or SEND 900 Ω pushbutton.

3.3.4.1 Continuous Mode

Press the GENERATOR-KHZ CONT pushbutton. Use the FREQUENCY and LEVEL controls to adjust for the desired send level and frequency as indicated on the displays.

3.3.4.2 100.4 Hz Step Mode

Press the GENERATOR-KHZ STEP pushbutton. Use the FREQUENCY control to adjust the send frequency in 100.4 Hz steps, and adjust the LEVEL control for the desired send level as indicated on the displays.

3.3.4.3 Fixed Frequency Mode

Press the desired frequency pushbutton. This automatically selects the 100.4 Hz step mode at the proper frequency.

Press the GENERATOR-KHZ 1.004 pushbutton in order to send the 1004 Hz test tone. The send level is adjusted using the LEVEL control.

3.3.4.4 Send Level Measurement

The send level is selected by pressing the desired LEVEL pushbutton. When the OFF pushbutton is in, a quiet termination is applied to the send terminals. In the VAR mode, the send level is adjusted using the front panel LEVEL control. The third LEVEL pushbutton applies a fixed level (standard unit -13 dBm) to the send terminals.

In accordance with telephone company transmission level practices, the send level measurement is calibrated in terms of the level that will exist at the send terminals when they are properly terminated in the impedance selected by the SEND pushbutton switches. If the actual terminating impedance is different

from the selected impedance (600 Ω or 900 Ω), send levels other than that indicated will exist at the send terminals. The actual level across the send terminals may be verified using an external meter or temporarily bridging the Model 42-10 receive terminals (in the bridge mode) across the send terminals. The receive impedance must be the same as the send impedance.

3.3.5 Dial/Talk Operation

This section contains the operating instructions used for either 2-wire or 4-wire dial/talk mode of operation.

3.3.5.1 2-Wire Dial/Talk

Set the 2W/4W switch to 2W. Connect the lineman's handset to the 2W DIAL/TALK connectors. Set the DIAL-TALK/MEAS switch to DIAL-TALK. This connects the lineman's handset across the line. Using the lineman's handset, dial-up the desired line. When the desired connection has been made, set the HOLD/OFF switch to HOLD and the DIAL-TALK/MEAS switch to DIAL MEAS. Measurements can then be made on the dialed-up line. Communications of a dialed-up line can be made by placing the DIAL-TALK/MEAS switch to DIAL-TALK. The lineman's handset may be left connected without adversely affecting the performance of the Model 42-10.

When the NORM/REV switch is in NORM, the 2W dial connectors are connected across the NORM/REC line. When the NORM/REV switch is in REV, the 2W dial connectors are connected across the NORM/SEND line.

To dial out on both lines, set the DIAL-TALK/MEAS switch to DIAL-TALK and dial-up the desired line. Once the desired connection has been made, set the HOLD/OFF switch to HOLD and set the NORM/REV switch to its opposite position. You can now dial-up on the second line. If a dial tone is not present, go on-hook on the lineman's handset and then back to off-hook to obtain a dial tone. Once both connections have been made, set the DIAL-TALK/MEAS switch to DIAL MEAS.

3.3.5.2 4-Wire Dial/Talk

The Model 42-10 supplies an internal talk battery in the 4-wire dial/talk mode. The unit will interface with both wet and dry 4-wire facilities and will provide full talk/listen operation without external batteries.

Connect the headset to the 4-wire connectors. Set the 2W/4W switch to 4W. Set the DIAL-TALK/MEAS switch to DIAL-TALK. This internally connects

the headset receiver to the output of the receive amplifier and connects the headset microphone to the input of the send amplifier. The talk and listen functions on the incoming lines can be interchanged by reversing the NORM/REV switch.

Normal measurements can be made by setting the DIAL-TALK/MEAS switch to DIAL MEAS. Communications over the lines can be made by placing the DIAL-TALK/MEAS switch to DIAL-TALK. The headset may be left connected without affecting the performance of the Model 42-10.

3.3.6 Battery Check (Optional)

When supplied with the optional rechargeable battery pack, the Model 42-10 will always be recharged when the line cord is plugged into an active power outlet. The front panel POWER switch does not control the charging function.

The battery pack provides automatic shutdown and a battery charge indicator LED. This LED will give a visual indication of the state of charge when the AC/BATT switch is in the BATT position. For proper indication, the ac line cord must be disconnected. (With the ac line cord connected, the battery indicator monitors the output of the battery charger.)

The LED will be on when the Model 42-10 is operating from the battery pack and the battery voltage is above the cutoff threshold.

WARNING: When the instrument is in the auto shutdown mode, the load is disconnected from the battery. When this occurs, the battery will recover slightly and may cause the battery indicator LED to come on. If the LED flashes or is off, the POWER switch should be placed in the AC or OFF position and the unit connected to an active ac power outlet. This will recharge the battery pack and increase the useful life of the batteries. Under no conditions should the batteries be left in the discharged state for an extended period of time.

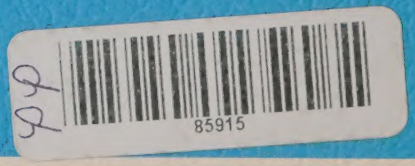
The HIGH/FLOAT charge switch (located on the bottom of the chassis) controls the magnitude of the voltage used to charge the batteries. The switch is normally left in the FLOAT position which keeps the batteries charged when the unit is connected to the ac power line.

In the FLOAT position, the battery pack is on charge at a constant potential slightly greater than the normal open circuit voltage of the battery. In this position the Model 42-10 may be left connected to the ac line continuously without harming the battery pack.

In the HIGH position, the battery pack is on charge at an increased potential so that the battery pack may be recharged more rapidly after a deep discharge. This position should only be used when the Model 42-10 has been in the automatic shut down mode or when the battery pack capacity appears to be decreasing.

WARNING: In the HIGH voltage mode, the battery pack is recharged in 12 to 20 hours depending upon how deep the discharge was and how long the battery has been left discharged. After this time the HIGH/FLOAT charge switch must be placed in the FLOAT position.

The Model 42-10 should not be left connected to the ac line for more than 30 hours with the switch in the HIGH position. If the batteries remain under a high voltage charge for an extended time, they will undergo overcharging, lose electrolyte and age prematurely.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